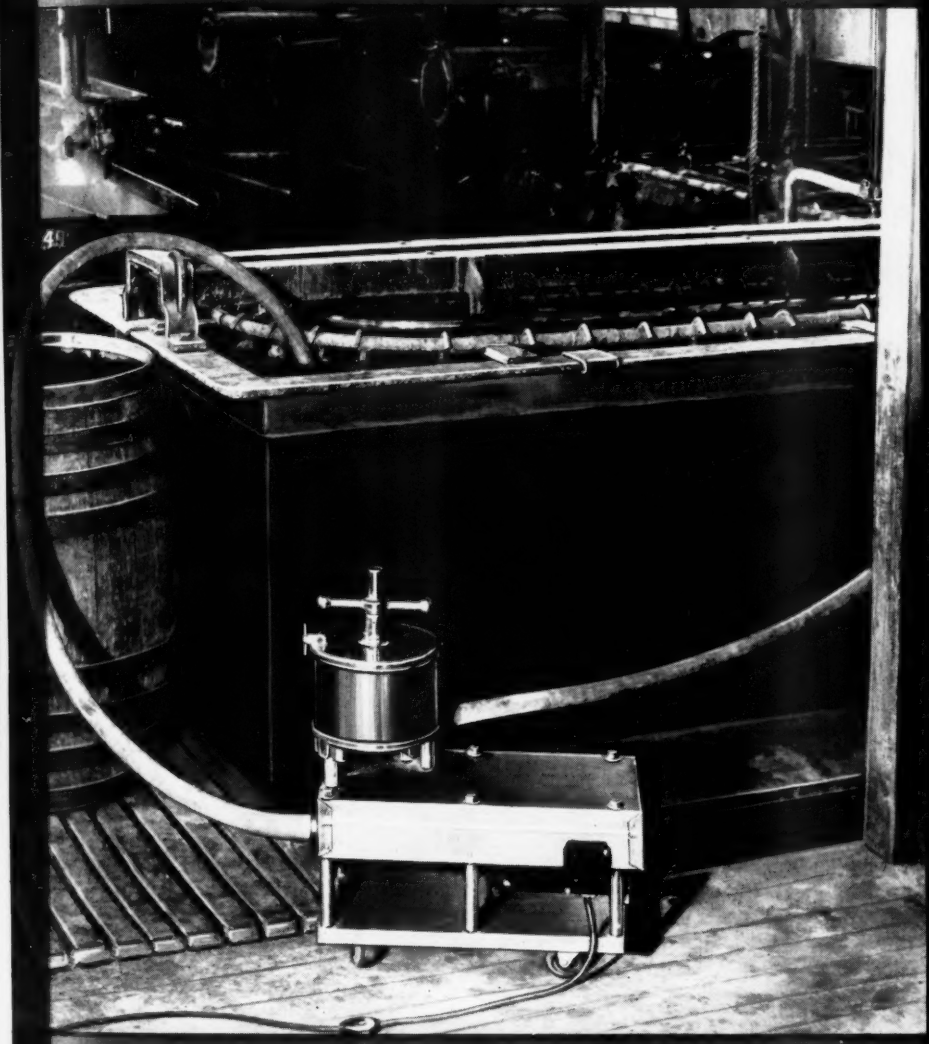
The Monthly Review

AMERICAN ELECTROPLATER'S SOCIETY



A SOCIETY FOR THE ADVANCEMENT OF THE SCIENCE OF ELECTROPLATING

AUGUST — 1942

Munitions Burring with Clepolon Process

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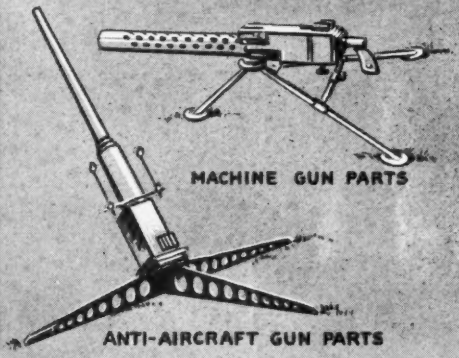

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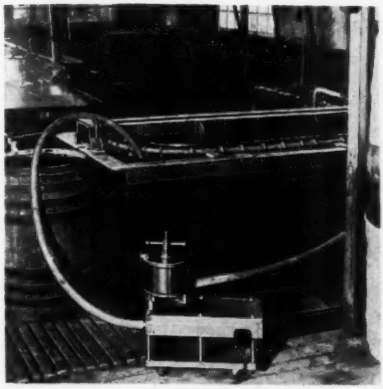
The Monthly Review

VOL. XXIX AUGUST 1942 NO. 8



THE COVER

Alsop Engineering Corp.
Milldale Conn.

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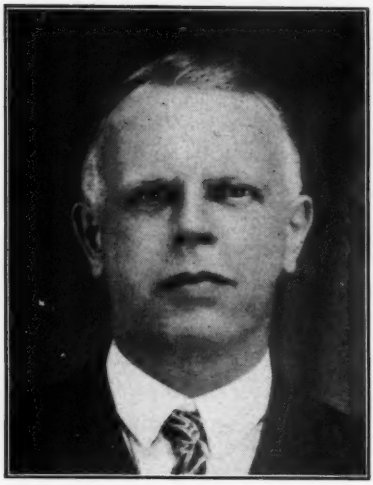


William J. R. Kennedy

It was a distinct shock to learn that the Executive-Secretary of the A.E.S., Mr. W. J. R. Kennedy, passed away early in the morning of August 7, 1942.

To those of us who have known Bill for a period of years, the personal loss and the loss to the Society as a group is greater than can be expressed in words. If we look back and realize, Mr. Kennedy was in charge of finishing at the Springfield plant of the Westinghouse Electric and Manufacturing Company for several years and in that position was called on as a consultant by the other branches of his company. To show the strength and convictions of the man and his willingness to sacrifice his

personal welfare for that of the Society, he gave up his position and took over the duties of Executive-Secretary and Treasurer of the Society and Editor and Business Manager of the MONTHLY REVIEW. He made this change when there was no precedence for a full time paid employee of the Society and with no assurance that the Society would be able to finance a paid employee permanently. Due to his farsightedness and his loyalty to the Society, the Membership has been doubled, the finances have been put on a sound basis and the affairs of the Society have progressed so far that they are now taken as a matter of course. To do this Mr. Kennedy worked unlimited hours a day, has traveled wherever his services could be useful and has called in his family to assist in the work without additional remuneration. It can be truthfully said that the Society's present financial stability is completely due to the efforts of Mr. Kennedy.

From my own personal knowledge I have known many cases where Mr. Kennedy traveled late at night to save time, I have known him to travel to some branch that was in difficulty when it meant several days away from his home and I have known him to discuss branch matters hours on end in order to solve some local difficulty.

To say that the Society as a whole has suffered a loss is to understate the matter; to say that every officer who has worked with Bill Kennedy has suffered a personal loss is to understate the matter; to say that Bill Kennedy has fostered the progress of the Society is to understate the matter.

We wish to extend our deepest sympathy to Mrs. Kennedy and the other members of the family for their loss and can assure them that the Society will not forget the united efforts of the family for our benefit.

Editorial

Now that the 1942 Convention is over, we are looking forward to very appropriate Educational Sessions for our Branch Meetings as well as the next Convention. We are, and I hope always will be, an Educational Society for the Advancement of the Science of Electroplating.

As I was appointed Chairman of the Educational Program by our President Charles Conley, it becomes my duty to secure speakers and motion picture reels of outstanding value in our field. As this is not a small task, I enlist the support of all the Branch Librarians.

I am asking all Branch Secretaries to send me the names and addresses of their Librarians in order that I may communicate with them direct. I have no doubt that most of the Branches are already lining up speakers for their Educational Programs and do not need any assistance from the Supreme Chairman. Never-the-less I believe it is wise to send a list of available speakers to all Branches.

For the past two years a few of our Branches, especially Newark Branch, have had some very interesting programs. Members from the Branch were solicited to write short papers on subjects with which they were most familiar. The time allotted for the papers was 15 minutes when three speakers were scheduled and 20 minutes when two speakers were scheduled, with an extra allowance of 10 minutes for discussion on each paper. There were also several "Information Please" programs for which 3 experts were selected to answer all questions, regardless of their nature.

This type of meeting creates a lot of interest and tends to increase the attendance. I hope that more Branches will adopt this type of program, in-as-much-as I feel that outside speakers will be very hard to secure due to the present war situation. However, I shall make every effort to secure as many speakers as possible.

Anyone reading this article and knowing of a prospective speaker will do me and the Society a great favor by informing me of his name and address. Please do not hesitate, as we are always looking for new subjects.

GEORGE WAGNER,
Chairman, Educational Committee.

Conservation *of* Plating Materials

Presented to the Los Angeles Branch of the American Electroplaters' Society by J. A. Raskin of the Udylite Corporation, Detroit, Michigan, and read at the Annual Educational Session on March 21, 1942 by Mr. Frank Bunker.

TODAY, when we are engaged in a struggle to maintain the democratic ideals of our country and its allies, it becomes a patriotic duty and necessity to operate our industries at maximum efficiency and speed. This problem is made increasingly difficult due to the shortages of almost all materials and supplies normally used in the plating and finishing industry.

In the past we have been wasteful of materials, because labor costs were reduced at a sacrifice of material consumption. The trend to faster production lead to higher current densities, with higher power loss from poor conductivity of hot bus bars, from higher anode and cathode polarization, and from lower cathode efficiency.

In most cases conservation of materials was economically justified but totally neglected. Today we must adjust ourselves and meet the problems as they arise with ingenuity and good common horse sense.

I have compiled some suggested methods for conserving plating materials that I believe will be helpful:

Cleaning:

Cleaners and cleaning methods have long been the bane of platers. There are some self-evident facts that should be followed. Use the concentrations and operating conditions recommended by the vendor, or found best by you, and control the cleaner by the following methods.

(1) Maintain a constant temperature in the cleaner solution. This can be done simply with the use of a thermometer and steam valve, or it can be controlled by temperature regulators. Obviously, if the temperature fluctuates, the conditions for successful cleaning will be in a constant flux, and one more variable will be added to an already complex operation. (2) Control the effective alkalinity by chemical tests and physical observations. Titration of the cleaning bath is a reliable method for checking the amount of alkali present. For example, a titration for active alkali to a phenolphtalein end-point, followed on the

same sample to a methyl orange end-point will show both active and inactive alkali present. Based upon satisfactory titration values, it is possible to fortify the bath suitably to maintain peak efficiency.

Another determination which is used to supplement the titration values is the determination of pH. It is probable that baths for specific purposes will operate at maximum efficiencies at given pH and titration values. In other words bath strength as pH, and quantity as the titration value of the alkali, must be determined.

The recently developed materials used in cleaners may be weaker alkalis (as to caustic strength) than older types, but they are effective detergents because of their complex structure; water softening and lime suppressing qualities. Therefore, the pH titration values may vary for different type cleaners. A standard should be set at the start of a cleaner bath, and maintained to that figure.

Another test that can be used in evaluating cleaners, is to determine how much of a given quantity of mineral oil or lanolin will be emulsified by given concentrations of cleaner.

Electro-cleaner efficiency should be controlled also by the determination of current consumption to obtain unit cleanliness.

Solvent Degreasing:

I will not discuss the method of removing grease by the use of solvents such as trichlorethylene. The method and equipment is familiar to all.

However, since the shortage of this type of solvent, it pays to reexamine solvent degreasing.

First, in many plants the operation of degreasing equipment is not used at top efficiency, resulting in solvent loss. The most serious loss is that by drag-out, and vapors escaping. Time plays an important part in all cleaning, and is reduced to a minimum in solvent degreasing due to the fact that no chemical reaction takes place. If the machine is not designed properly, and the heat input is not sufficient, loss in solvent will take place. If the temperature of the parts being degreased is not raised to the boiling point of the solvent in a minimum time, the material will be withdrawn wet, resulting in loss of solvent, or the parts will have to stay in the degreaser until heated to this temperature, which will take more than the allotted time.

The common causes for loss of vapor can be caused by drafts across the tank, putting in too large a bulk of work displacing the vapor, and withdrawing the work from the machine too quickly, disturbing the solvent vapors. The work should be removed from the machine slowly not exceeding 11 ft/min.

Pickling:

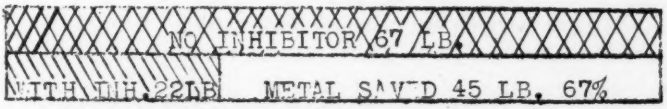
Many of the control methods mentioned previously under alkaline cleaner control are applicable to the control of acid dips.

Maintain the acid concentration by titration with a standard alkali.

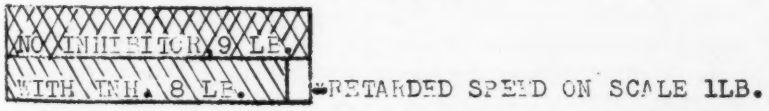
Prevent contamination of the acid dips with grease and oil by providing proper cleaning methods. Occasional carbon treatment of the acid dips may prove practical if shortages occur of the common acids.

Operate acid dips at lowest concentrations possible, to prevent dragout and greater spray losses.

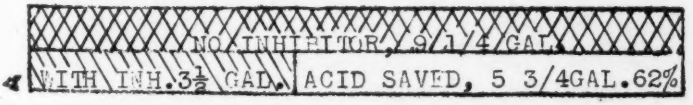
SLIDE ON INHIBITORS



ILLUSTRATING THE EFFECT OF INHIBITORS FOR CONSERVING METAL.



ILLUSTRATING THE EFFECT OF INHIBITORS ON THE ACTION OF THE ACID ON SCALE.



ILLUSTRATING THE EFFECTIVENESS OF INHIBITORS IN CONSERVING ACID.

Use inhibitors which will permit the removal or rapid solution of the various scales or oxides, and retard the action of the acid on the metal.

The mechanism of an inhibitor is that the inhibitor, being a finely dispersed colloid, will surround and adhere to the metal. The pickling acid will react on the scale and form a ferrous or ferric salt, which dissolves in the bath. Its action on the base metal, which ordinarily liberates hydrogen, will not occur to as great an extent, since the inhibitor prevents this hydrogen formation or further oxidation. The inhibitors, therefore, have a definite effect upon hydrogen embrittlement.

To sum up the functions of an inhibitor, it may be said that:

(1) It does not interfere with the normal operation of the acid.

(2) It prolongs the life of the acid, since less metal is dissolved and the amount of the iron salts accumulated is smaller.

(3) It saves the base metal, and helps to prevent overpickling.

(4) Not only does it prevent embrittlement to a great degree but it also helps to preserve the bright, smooth original iron or steel surface, and thus aids in obtaining smoother, brighter electro deposits.

The effectiveness of inhibitors in conserving acid and to action on scale can best be seen by the following slide.

Plating:

The different sources of losses may be classified as follows:

1. Poor plate distribution on the work.
2. Plating on racks, barrel, and tank sides.
3. Drag out of plating solution.
4. Contamination, decomposition and purification of plating solution.
5. Rejects.

Plate Distribution:

It is well known that the thickness of the plate may vary from load to load in a tank, from piece to piece on a rack, and from point to point on a piece. Considerable savings can frequently be accomplished by increasing the uniformity of coating.

Variations in Thickness from Load to Load:

These variations appear both in still tanks and in barrels, and are caused by variation in time and current.

Time variations are difficult to avoid, unless timing equipment is employed.

Variations in current must be prevented by the operators. To assist them, current charts should be prepared for the different parts plated. These charts should preferably be based on a tank load consisting of certain number of racks or pieces.

Variations in Thickness from Part to Part:

In barrel plating the uniformity of plate thickness is governed mainly by three rules.

Only a certain proportion of the total load is being plated at one time, namely, those parts which are in the direct path of the current. Those toward the center of the load are shielded by the parts surrounding them, and do not plate at all unless the rotation of the cylinder brings them to the surface. This takes place only when the cylinder is half filled or less. If more work is put into the barrel than one-half of its total capacity, the center portion of the load stays in the center, while the work on the outside rolls around there. Thus the first rule for uniform plate is this; never, fill the barrel cylinder more than half full with work.

Another factor of importance, is that the individual pieces must tumble fairly freely. Parts which nest together, such as open helical springs, and parts which stick together, such as light flat parts and cup shaped parts of the wrong curvature, cannot be barrel plated satisfactorily unless other parts can be mixed in with the load to break it up. The second rule, is, therefore, do not barrel plate parts which stick together during plating and expect to get good plate distribution.

Finally the work must make good contact with the cathode dangler.

In still tanks or in automatic plating, variations in thickness from part to part are caused by three factors; namely, No. 1 varying resistance in the electrical contact, No. 2 varying resistance to different portions of the rack and No. 3 varying space relations between different pieces in the tank and between these pieces and the anodes.

Variations in Thicknesses from Point to Point on Individual part:

To properly discuss this general heading, it is necessary to consider the plate distribution. We do not have time today to

go into this subject, as it is a large one, and would take a great deal of time to properly cover it.

I think of no better illustration of plate distribution, than the demonstration that Walter Pinner of General Spring & Bumper Corporation gave on the importance of proper racking of parts, which do not require any plating on the inside. There are shown in the following slides. Since his discussion is very much to the point, it is quoted almost verbatim.

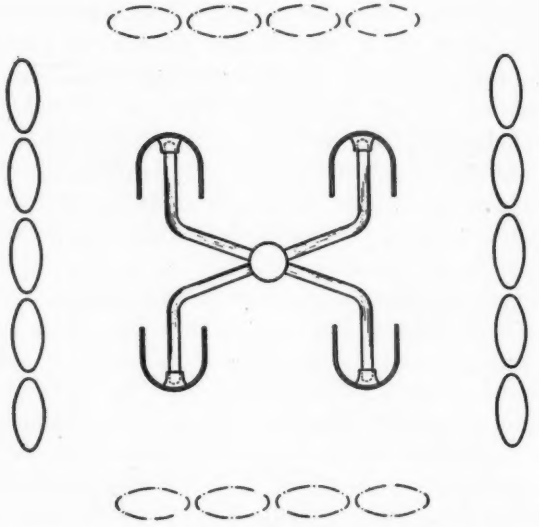


Fig. 13

In these figures, the article portrayed may be any one of dozens of metals, stampings, or castings. They may be hub caps, door handles, bumper guards, radiator grilles, pots or pans. Specifically, they represent formed metallic articles having an outside, significant surface to be plated to a thickness specification. The inside is not significant and, constituting the back, is not polished and is preferably not to be plated.

This slide suggests an article having three significant surfaces and in which the linear dimension of the face is approximately equal to the dimensions of the two sides. The anodes, represented by the heavy lines, are placed in a manner actually noted by the author in an otherwise well regulated plating plant.

With only a casual study of the set-up shown, several conditions will be seen to be incorrect. Bearing in mind that these pieces are being plated to a thickness specification, it is at once obvious that each of the four pieces will be plated to a certain thickness on the sides nearest the anodes. This thickness will prevail around a large part of the front of the piece and then diminish to a low value on the other side, opposite which there are no anodes. Obviously, if the rack be turned 90° from its present position, facing the solid lined anodes as shown, better plate distribution will be obtained. The plate, dependent upon the actual size of the articles and the distance of the front of the pieces from the anodes, should be fairly uniform, depending, in turn, upon the spacing of each piece to its neighbor.

With this spacing determined, and anode to cathode distance fixed by plate thickness measurement, one other fault remains to be adjusted for sake of economy. The pieces should be moved more closely together, back to back, to prevent the waste of anodes on non-significant surfaces. In general, such pieces should be racked as closely together, back to back, as is physically possible to accomplish.

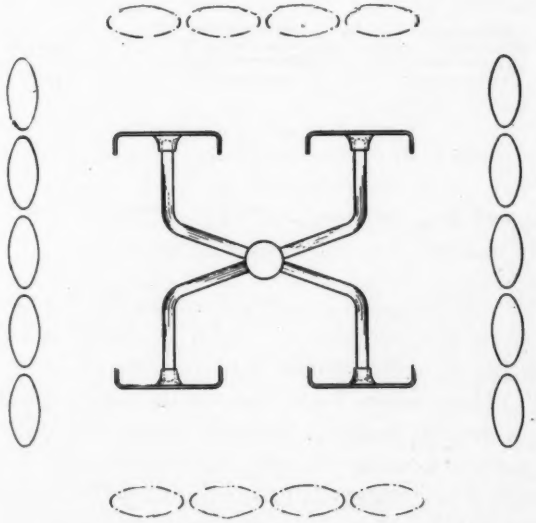


Fig. 14

The next slide presents pieces, racked for plating, which again

may be any of countless fabricated articles. In this case, the front dimension of the pieces is relatively large as compared to the side dimension. Again, the back is a surface not to be polished or plated upon. It is hardly possible that any well-informed plater would process the pieces in the position shown as regards the anodes shown in solid lines and yet such practice would not be as ill-advised as the set-up originally shown in Figure 13. In such position, the plate thickness on the front, constituting the most of the surface, if meeting the thickness requirement, would leave only a small section over-plated and a small section underplated.

Obviously, the proper set-up is that represented by the anodes shown as dotted lines, and again one need be careful only of the spacing of each piece to its neighbor and, as before, the pieces should be moved closer together, back to back.

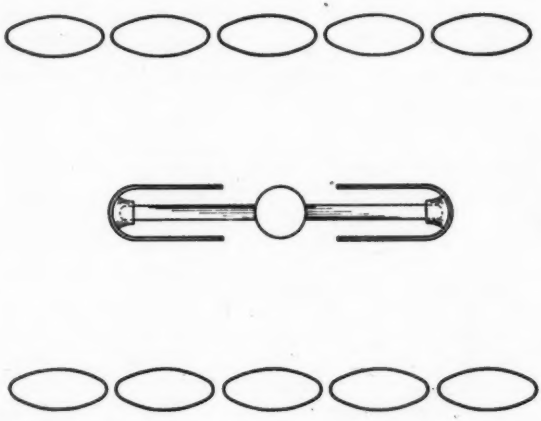


Fig. 15

The next slide suggests pieces having the side dimensions large in comparison to the front dimension. Two pieces only are shown on one plating figure. The author can conceive of no way to place four such pieces on one rack, and obtain proper plate distribution with a normal anode to cathode distance. With only two pieces on one rack spline, the operator needs only to space the piece properly with relation to its neighbor on the next spline to secure good plate distribution. Obviously, with the cathode dimension narrow, an additional cathode compartment may be set up and utilized in a tank of any given width.

In the above illustrations, the articles shown consist of plain surfaces. Logically, deviation from plain surfaces into intricate design further complicates the picture. However, it is usually possible to classify articles in some one of the above three and employ the general principles outlined. Departure from plain surfaces involves the use of increased ingenuity and more careful examination of results obtained by plate thickness measurements.

Properly constructed and maintained *barrels* do not tree. Electrical contacts should be removed for de-plating at regular intervals. When they would be attacked on stripping, i.e. if they are chromium plated, they should be cleaned mechanically and the scrap kept separately for remelting or exchange.

Drag-out of Plating Solution:

Drag-out is solution adhering to the work and transferred with it to the next tank, ordinarily a rinse tank in which it is lost.

The volume of the drag-out increases with the speed with which the work is removed from the solution, decreases with the time of drainage above the solution, and varies with the shape and size of the part. Cup shaped parts drag out the biggest volume of solution, short flat parts in vertical position the least. If parts drain on each other, the drag-out is increased. The volume of the drag-out generally varies between about .4 gallons/1000 sq. ft. of work for perfect drainage, and 24 gallons/1000 sq. ft. for some cup-shaped articles.

Studies of drag-out *by the writer and others* has shown many ways in which *drag-out can be minimized.*

1. Use as dilute plating solutions as possible to minimize viscosity, and to keep the cost of the drag-out at a minimum. This is particularly necessary when thin flash coatings are applied. Such coatings carry with them as large a volume of drag-out as heavy coatings and the ratio between metal lost by drag-out and used in plating is tremendous.
2. Allow the parts to hang on a rod over still tanks or semi-automatics throughout *one* cycle of operations, and to pass over an empty tank in a full automatic when possible.
3. Remove the parts slowly out of the solution and transfer

quickly if total transfer time must be short. Make the racks light to conserve the strength of the operator.

4. Parts which go deep into the tank should be removed slower and allowed to drain longer than short parts.
5. For minimum drag-out the parts should be extended horizontally rather than vertically.
6. Rack parts so that solution can flow off at a tip or a corner. Avoid having flat horizontal surfaces on the rack.
7. Empty cup-shaped parts carefully after their vertical surfaces have drained, or still better, provide drainage holes large enough to empty the cup completely during the drainage time. See to it that drainage holes are not closed after dies have become worn.
8. Stream-line the racks and keep them in repair to avoid pocketting of solution.
9. Never rinse a plating barrel. Rotate it a few times by hand after it has been raised out of the solution.
10. Where warm plating solutions are used in full automatics, make up for evaporation losses by spraying a fine mist of water and air on the parts while they are still above the tank.
11. Place drainage boards leaning toward the plating tank, between it and subsequent rinse tanks, in full automatics.

In many instances, a part or nearly all of the remaining *drag-out may be saved.* The following means are suggested:

Use at least one drag-out tank of a minimum volume immediately following the plating tank. When expensive or very scarce metals are plated, use several drag-out tanks in a row. Use the solution in the (first) drag-out tank to replenish evaporation and spray losses from the plating tank. If the plating solution is operated cold and evaporation is slow, evaporate the (first) drag-out solution at intervals using waste steam if available, and add the concentrated solution to the plating tank. Use a low evaporation temperature for cyanide solutions and remove carbonates before adding to the plating tank. Silver and gold may be precipitated with zinc dust and sold to refineries. Cadmium may be plated out on steel dummies which are used as anodes in the plating tank. As the first drag-out tank is emptied, fill it with solution from the second drag-out tank etc., and add clean water to the last drag-out tank.

Chromic acid spray should be recovered with a moisture extractor placed in the ventilating duct as far away from the plating tank as possible.

Contamination, Decomposition, and Purification of Plating Solutions:

Materials which contaminate plating solutions, and decomposition products of bath constituents, are frequently removed at a sufficient rate by means of the drag-out in order to avoid frequent purification. When drag-out is reduced or eliminated, these substances may accumulate so fast, as to make frequent purification necessary. Since purification is frequently accompanied by considerable losses, it is necessary to take steps to prevent such losses. This can frequently be done with very little effort.

The first step in preventing *contamination* is to recognize the nature of the contaminant and determine its source. The action of most inorganic and some organic impurities is well known. A list of common paths of contamination is as follows:

1. Parts fall to the bottom of the tank and dissolve chemically, anodically, or as intermediate electrodes. They should be fished out at regular intervals. Since "fishing" riles up sludge, it should be done at the very end of working periods.
2. Foreign solutions drip into the tanks from barrels or dipping baskets crossing overhead, from the floor above, etc.
3. Solution splashes from one tank to another.
4. The same rinse tank used subsequent to plating with one solution, is also used before plating with another solution.
5. Fumes from one tank, notably chromium tanks, are blown into another tank, sometimes from one end of a building to another depending on prevailing winds.
6. Drippage of solution on anode rods and work rods causing them to dissolve.
7. Lead is dragged in from a lead-lined tank with muriatic acid or dissolves from (anodic) lead coils.
8. Inexperienced help makes the wrong additions.
9. Improper tank linings, rack coatings, insulation on

electric cables, filter hose, etc., dissolve in bright nickel solutions.

10. Cleaners and pickling acids enter the plating bath because of insufficient rinsing.
11. Oil is brought into the bath from insufficient cleaning, or reprecipitation on the work in the acid dip on account of insufficient rinsing.
12. Oil is sprayed into the tank from leaking air lines.
13. Polishing dirt settles in the tank.
14. Wetting agent in a previous bath is not removed from the surface of the work.

Two types of plating solutions suffer from *decomposition*, namely cyanide solutions and solutions containing organic addition agents.

The decomposition of cyanide solutions and consequent formation of carbonates is minimized by:

1. Operation at as low a bath temperature as possible.
2. Operation at maximum pH.
3. Avoidance of air agitation.
4. Avoidance of use of insoluble anodes alone.

Addition agents should be chosen so as to assure their stability in the bath.

When purification must be undertaken, great care is necessary to avoid large losses. Some important points are:

1. Use tanks with sloping bottoms and sumps at the end from which the solution is pumped.
2. Maintain the filters and save all solution leaking out of filter presses.
3. Avoid the losses which occur when the filter is taken apart unnecessarily by a. using low filtering pressure which minimizes clogging and b. settling the sludge in the tank by the addition of filter aid before filtering.
4. Drain filter and pump after use into a drum and keep this solution until the next filtration.
5. Do not wash the filter cake after carbon filtrations or use the wash water without repurifying it before it is added to the tank. It may contain the impurities just removed.
6. Avoid precipitation of nickel salts when raising the pH for purification. The impurities precipitate at a lower pH than the nickel.

7. When dummying, plate out as little metal as possible with the impurities by *a.* using nickel plated steel screen dummies (10 min. nickel is sufficient) or corrugated steel dummies, *b.* providing Maximum agitation, for example with a circulating pump, and *c.* controlling the current density so that the dummies are black *at all times.*
8. Drain frozen out carbonates quickly and well, and drain sludges well before throwing them away.

Rejects:

Almost everything which will reduce the percentage of rejects pays its way. Three general methods are suggested which should be used simultaneously.

The first method involves *inspection prior to plating* and rejection of parts which show faults which cannot be rectified in the plating room. Rackers, properly chosen and trained can often do all that is necessary, at small additional cost.

The second method deals with *continuous* control of all solutions. (A single analysis does not tell very much unless it can be compared with previous analyses and coordinated with other facts of operation. Some simple bookkeeping is necessary. The following information should be available for each bath:

Tank number
Capacity in gallons to standard solution level, 1 oz/gal. .....lbs/tank.
Regular schedule of all additions, including salts, anodes, brighteners.
Regular schedule of analyses.
Standard bath composition.
Result of analyses with dates.
All additions made with dates.
Work run in tank-type, quantity, specification, thickness test results and dates.
Voltage at generator and tank and amperage if possible with dates.
Space for remarks.

This sort of data, religiously kept will provide much help in keeping production going in a satisfactory manner.

The third method depends on inspection of all rejects from the plating room. A well organized, detailed reject report is an

invaluable means of control. The inspector should be taught by the plating foreman to recognize each kind of fault which is reason for rejection. That is time exceedingly well spent. He should then be given slips of paper with the inspector's name, the date and the shift, on which are already listed these reasons for rejection, and make a mark before the proper one when a part is rejected. At the end of the shift, each column is added and the total is ascertained. By keeping a record from shift to shift and from day to day, trends will be observed which can be corrected before things go bad. Not only will it indicate what happens to the various solutions, but it will also put responsibility on the operators, if the work is properly subdivided among them. Furthermore, faults in base metals and previous operations are indicated and can be corrected. Such detailed rejection reports are also helpful in establishing the time period between purification of plating solutions, dumping of cleaners and acid, and similar all-important control measures.

J. A. RASKIN

WALTER PINNER ACCEPTS

President Conley announces that Mr. Walter Pinner has accepted the chairmanship of the Paper Awards Committee for 1942-43.

Thank you, Walter. We know the job will be well done.

JOINT EDUCATIONAL SESSION

Toronto, Rochester, and Buffalo Branches, Joint Educational Session at the General Brock Hotel, Niagara Falls, Saturday, October 24, 1942.

Speakers: William Phillips, Arthur Logozzo, possibly Dr. Blum.

It is hoped that some of the National Officers also will be present.

Mr. Edgar L. Proctor
114 Seeley Ave.
Arlington, New Jersey
Dear Mr. Proctor:

Your name has been spoken with so much deference and depth of feeling by Electroplaters', that I was very happy to have this opportunity of having a little contact with you, even in this way.

I very much appreciate the distinction of having been named as the winner of your award for having given a paper at your Grand Rapids Convention, and I hope that I will have the opportunity of some day meeting you and enjoying the friendship that so many others feel so strongly.

Very sincerely yours
HARPER J. RANSBURG COMPANY.

PREPRINT: Courtesy TURCO Products, Inc.

"Automatic Zinc Plating as Applied to Strip Coating"

By W. CARTER NEWLOVE
Engineer, Lifetime Products, Inc.,
Los Angeles, Calif.

To the members of the Los Angeles Branch American Electroplaters' Society Meeting on April 8, 1942:

Strip plating is defined as the continuous plating of strips of ferrous or non-ferrous metals and is done for protective or decorative purposes. Such plating is done chiefly to protect the base metal against corrosion. There are several kinds of coatings applied commercially today. The commoner ones are copper, tin, and zinc. Just recently the electrolytic "tin line" has received a great deal of attention and a number of these lines are being installed in tin plate mills today.

The advantage of continuous strip plating over the hot dip coating of strip is obvious to any electroplater. The further advantage of continuous strip plating over the hot dip coating of single sheets is even more evident.

Zinc Plating

We shall be concerned only with zinc plating of continuous strip or "zinc line." Zinc plated strip is widely used for such products as box strapping, shingle bands and venetian blind slat stock, etc.

Equipment Required

The equipment required to produce continuously plated strip steel is the same equipment as is used by electroplaters for regular work with the exception of the special equipment necessary to handle material in coils.

First, of course, is the power source which may be any satisfactory source of low voltage, direct current, such as is generally used in electroplating.

Tanks to hold the plating bath are required and these tanks are constructed of various materials depending on the type of bath to be used, whether alkaline or acid. These tanks, due to the particular nature of the work which they are to handle, are

usually much longer and narrower in proportion to their volume than the ordinary electroplating tank. The exact dimensions of the tank can be determined by the width of the work to be handled, and by the rate and time factors involved in the amount of material which is required to deposit, and the length of time available for a specified thickness of coating. Obviously a tank for strip plating which is intended to accommodate large quantities of very narrow strip should be long enough to permit each unit of area to remain in the bath a sufficient time to receive the desired coating. The length of time in the bath is, of course, affected by the current carrying capacity of the strip to be plated, the number of contactors which can be introduced into the circuit and the amount of power which is available. It is, of course, evident that the designer who has a specified amount of material to handle in a particular time has the option of running a single strip or a small number of strips simultaneously through a shorter tank. Generally the smaller number of strips in the longer tank is used because of the greater simplification of the rewinding equipment.

Accessories

The special accessories required for strip plating are, first, the handling equipment necessary for moving heavy coils of steel around the factory and introducing them into the coil boxes for feeding the equipment. Second, it is also necessary to have coil boxes, strip transfer sheaves and guides, so that the material can be passed into the bath and directed in the proper direction during its passage.

After the strip has passed through the bath and has been washed and dried, some means must be provided for rewinding the strip into coils, so that it may be conveniently disposed of within the plant. Control accessories for current and bath control are very important. For current control, the strip plater will use the same equipment the regular electroplater uses which, as all of you know, involves the use of rheostats, and devices for measuring current, such as the Sangamo ampere hour meter. For solution control, the strip platers use the same control that the job platers use, and with which we are all familiar. The Solu-Bridge; pH meters and chemical test sets, such as Kocour

and Hanson Van Winkle-Munning, are likewise familiar to all of you.

Solutions

The strip plater has a number of solutions to choose from, the principal types of zinc plating solutions being the acid and alkaline baths. The acid-zinc bath is the one most generally employed by strip platers. It is a cheaper bath to maintain than the alkaline bath, produces satisfactory deposits, and is operated at very high current densities. This is, of course, an important factor to a strip plater who is required to get very rapid deposition. In our own case, we selected the alkaline bath, and are at present using the zinc cyanide bath made up of zinc, sodium cyanide, and sodium hydroxide. We chose this type of bath because it enabled us to use an ordinary steel tank, which could be fabricated on the spot and did not require any lining. We found that the alkaline bath gave us very smooth, fine grained deposits, and since brightness is of no consideration, we have used no addition agent or alloyed anodes.

We found that we could operate the cyanide bath at reasonable high current densities and temperatures. For example: When plating venetian blind slat stock, our strip tank accommodates three strips of this material simultaneously. This material is 1-7/8″ wide by .007″ thick, and since there is slightly over 45′ of each strip immersed in the bath at one time, you can readily see that we have approximately 45 square feet of surface in the bath continually. When we were able to get all of the steel we wanted and were running our equipment at full capacity, we fed 6,000 amperes at 6 volts into the strips which, as you can see, was about all the strip would stand without melting. This gave us a current density of 120 to 140 amperes per square foot.

This current density is, I believe, high compared to current density employed in the plating of smaller parts, but it is low compared to the current density employed in strip plating with acid-zinc baths where much larger amounts of current are used. In wire galvanizing, for example, acid-zinc baths are used with current densities as high as 2,000 amps per square foot. This, of course, gives very high deposition rates and necessitates frequent contacting of the wire and the use of cresote or some similar material on the surface of the bath, as a protection

against acid spray being thrown out by the hydrogen evolution at the cathode.

Cleaning

Treatment of the material before plating involves the same procedure as job plating. One very successful cleaning cycle employed is an alkaline wash and an electro-cleaning, a rinse, and acid dip and a rinse spray and wiping. The material then enters the bath and is coated and after leaving the bath is given a cold water rinse, a hot water rinse, and is then passed over a steam table for drying.

Alkaline cleaners, such as Turco Porokleen, are used very successfully for electro-cleaning. I also know of one instance in which a vapor degreaser was used as a pre-cleaner, and very good results were obtained. I also know of a particular application which handled only cold rolled strip from a certain mill using an easily removable rolling compound, where the only cleaning employed before plating was an electrolytic clean in a solution of sodium hydroxide and sodium cyanide.

The electrolytic cleaning of strip steel may be done either by direct or reverse current, but it is difficult to employ both direct and reverse current to clean a continuous strip.

After the strip has been plated to the required thickness, further processing may or may not be necessary, depending upon the ultimate use for which the strip is intended.

In the case of box strapping, for example, no further processing is necessary.

If, however, it is desired that the strip be painted, it is necessary to give the zinc coating some phosphatizing before painting, in order to get the best possible adhesion of the finish. There are a number of proprietary solutions and methods for accomplishing this purpose. If it is proposed to give a phosphate coating to the strip after plating, the time and rate factors involved in processing the phosphate coating must be considered in designing the plating equipment, so that the phosphatizing operation can be synchronized with the plating operation, and the strip allowed to proceed through the bath at a constant rate.

The Relation of Electrochemistry to Aluminum and Aluminum Alloys

I. ELECTROPLATING ALUMINUM—By Charles Cahn

By DR. EDWARD ENGEL & CHARLES CAHN
Colonial Alloys Company, Philadelphia, Pa.

Paper read by Dr. Edward Engel and Charles Cahn of Colonial Alloys Company, Philadelphia, Pa., at the meeting of the Philadelphia Chapter of the American Electroplaters' Society on June 26th, 1942.

FOR purposes of brevity throughout this paper the word aluminum will refer to pure aluminum and all aluminum alloys.

Aluminum has been acknowledged to be a very unstable metal and therefore difficult to treat especially from an electrochemical standpoint.

It has an unusual affinity for oxygen and that is why it plays an important part in the thermite bomb and other such applications.

On the other hand this affinity for oxygen causes aluminum surfaces to be persistently coated with a thin film of aluminum oxide. It is this oxide that has made it difficult to electroplate this metal. This film has likewise made it impossible almost to solder or braze aluminum correctly.

Many and varied attempts have been made to electroplate aluminum with indifferent success. One of the nearest approaches in this direction has been to anodize the aluminum, then to partially remove the coat and finally to electroplate. Some objections to this method have been the cost of equipment, time of preparation, restricted throwing power of the Anodizing pretreatment, and the inability to treat all the aluminum alloys. It cannot handle assemblies of alloys or soldered or brazed parts.

These difficulties have now been overcome by a "PREPLATING" process in which the aluminum is prepared for plating by a short time dip into a special alkaline solution. This solution is used at room temperature, and is non-electrolytic. Time of immersion of the aluminum in the solution ranges from 15 seconds to 1 minute. The throwing or covering power is 100% since the solution processes every part of the aluminum that it touches including corners, recesses, etc. Assemblies of varied

aluminum alloys can be processed in this solution as well as assemblies of aluminum and other metals.

The operating principle of this bath is as follows:—

The aluminum is cleaned by a caustic and nitric dip and then dipped into the "PREPLATING" solution. The caustic of the solution removes the superficial aluminum oxide coat and simultaneously, before the aluminum can pick up oxygen from the water of the solution, it preferentially accepts a zinc alloy, which coats the metal uniformly and firmly. The aluminum thus prepared is then rinsed and is ready for electroplating in most any standard plating bath.

Of special interest is the fact that zinc is deposited on the aluminum. At one time it was believed that zinc, in contact with aluminum, in the presence of an electrolyte, would cause the aluminum to corrode, according to their relative positions in the electromotive series. Theoretically this is correct, but it has been conclusively proven time and again that the zinc becomes *anodic* to the aluminum. This is explained by the fact that the zinc never is actually in contact with aluminum, as such, but with aluminum oxide which forms instantly on all exposed aluminum. The difference in potentials in this case, therefore, makes the zinc anodic to the aluminum. Thus the zinc becomes preferentially attacked thereby protecting the aluminum.

The process using this "PREPLATING" method is simple to install in that the only addition needed in a plating shop is a steel container for the solution. Copper, nickel, zinc, cadmium, brass, chromium, etc. may be plated directly over the prepared metal.

The plating of aluminum is becoming more and more vital to the war effort. Since a great part of the war is being fought in the air and since aluminum is the most essential metal in aircraft, plating of the metal for certain parts is highly desirable.

For example, radio receivers are being plated with silver for high frequency receptions. Other aluminum parts are being plated with brass for adhesion to rubber. Still other parts are being hard chrome plated for abrasion and wear resistance and for armor protection. Many aluminum parts are plated for solderability. There are numerous other applications for plated aluminum in aircraft which are essential to the highest efficiency of our air forces.

In order to actually demonstrate the simplicity of this "PREPLATING" process, arrangements have been made to copper plate samples of several different aluminum alloys and they will be available for examination.

After this demonstration of "PREPLATING" for electroplating aluminum and aluminum alloys, Dr. Engel will take over on the subject of high speed, low cost anodizing.

II. HIGH SPEED, LOW COST ANODIZING OF ALUMINUM—By Dr. E. Engel

Anodizing of aluminum is actually electroplating. The deposit instead of being a metal, is oxygen. It is possible to deposit oxygen on aluminum mainly because the affinity between the two is so great.

The affinity of aluminum for oxygen is the cause of the persistent air-coat of aluminum oxide that is always present on the metal when in contact with the air (or with water for that matter). This type of coat, however, is loosely held and can be taken off by rubbing or with cleaning compounds.

Another method of depositing aluminum oxide on aluminum is by chemical immersion in certain solutions, at elevated temperatures. This method coats the aluminum with a thicker, harder and more tenacious oxide than the air made coat. This is often used as a paint base, or for corrosion resistance, but cannot be considered hard enough to withstand any amount of abrasion.

Anodizing electrically, is the means to drive the combination of aluminum and oxygen together to form a hard, smooth tenacious coat of aluminum oxide, which has the properties of a paint base, corrosion resistance, abrasion resistance, coloring base and a good insulator.

Several methods of anodizing have been in common use, using as electrolytes, aequeous solutions of oxalic, or chromic or sulfuric acid. There have been other electrolytes and methods used, but this paper shall confine itself to those indicated.

The oxalic acid method of anodizing has for the most part been abandoned and the two types of present interest, especially during this war, are the chromic acid and sulfuric acid types.

Chromic acid anodizing is slow, requires close thermal control and is applicable only to certain alloys of aluminum. It is also

used where the sulfuric acid type would not be permitted (government specs.) in articles that have recesses or crevices, where the sulfuric acid might remain and cause corrosion.

Sulfuric acid type of anodizing is in general use today and is the fastest method of those considered above.

All of the above methods use direct current which requires a generator or rectifier and other complementary equipment.

Alternating current anodizing has been a long felt need. Various attempts at this have for the most part, produced a soft oxide coat and other complications, and were therefore unsatisfactory.

The method which will be demonstrated, employs alternating current and produces a hard uniform oxide coat of excellent character. Instead of a motor generator or rectifier, an inexpensive transformer is used.

During these days of restricted materials it is much easier to obtain a transformer than a generator or rectifier. It is even possible to make a home-made one without difficulty.

The electrolyte used is of the sulfuric acid type, modified with other salts and agents. This modification is the basis around which the efficiency of this method depends. The modification has a regulating effect upon the A.C. Current in the bath in such a manner that the efficiency of the electrolyte is unusually high. Current densities as high as 48 amps per sq. ft. can be used, as against the recommended 12 amps per sq. ft. for regular D.C. Anodizing. Allowing for the negative value in A.C. this permits up to twice the C.D. usually used in other approved D.C. sulfuric anodizing. Also, normal temperature rise does not affect the operation of the bath as it does in conventional sulfuric acid baths.

Among some of the outstanding features of this Army and Navy approved process for Anodizing aluminum (Spec. No. AN-QQ-A-696) are:

(1) Increased production due to increased permissable current densities and/or increased bath capacity (both electrodes used).

(2) Less delicate thermal control.

(3) Low cost and availability of equipment.
Less floor space and less maintenance.

(4) Greater volume of work in bath.

(5) Consistent quality of work turned out.

(6) Lower sulfuric acid concentrations are used resulting in harder coats and less solvent action on the aluminum.

(7) Tank need not be lead lined. Corrosion resistant coatings are satisfactory.

The methods of sealing and after treatments are similar to those known in the art.

III. A. C. ALKALINE HIGH SPEED ANODIZING

As equally important as is this method of sulfuric acid anodizing, is A.C. method of Alkaline Anodizing.

The use of this electrolyte is an excellent alternate for chromic acid anodizing. Employing A.C. it requires a low cost transformer in place of expensive difficult-to-procure D.C. equipment.

The oxide coat deposited is not as hard as the chromic acid coat but is sufficiently hard to be satisfactory.

The speed of oxide coating is approximately 3 times greater, more work is permitted in the bath, and greater production is possible in a given time.

The tank and cooling coils can be made of ordinary steel and much more efficient cooling and agitation arrangements can be devised because of this alkaline bath.

The oxide coat is colorless and of excellent appearances and quality.

The possibility of corrosion by trapped electrolyte in crevices and recesses is eliminated since the nitric acid dip, following the processing, neutralizes all excess salts and is itself non-corrosive to aluminum.

It is of importance to mention that the three processes described about (1) Electroplating aluminum (2) A.C. Acid Anodizing and (3) A.C. Alkaline Anodizing are very timely at this period due to anodizing bottlenecks and the need for better finished aluminum products.

These processes are being licensed to manufacturers and job plating shops and inquiries are invited.

COLONIAL ALLOYS COMPANY,
Philadelphia, Pa.

Aircraft Electroplating

By: R. R. JANSSEN
Process Engineer
North American Aviation, Inc.

Presented to the American Electroplaters Society, Los Angeles Branch, Annual Educational Session, March 21, 1942.

ELECTROPLATING is as essential to the airplane as the very rivets from which it is made. In fact even those rivets are electroplated by anodizing for protection against corrosive attack. This, corrosion prevention, is the most important reason for electroplating on an airframe. The motor, which combines with the airframe to make an airplane, will not be discussed here, but has been thoroughly covered in the March, 1941 issue of THE MONTHLY REVIEW of the American Electroplaters' Society. The three principal uses of electroplating on an airframe then are (1) to provide corrosion prevention, (2) to provide a smooth, hard bearing surface, (3) to provide a means of masking for selective hardening of steel parts.

The principal methods for plating to obtain corrosion prevention are anodizing for aluminum and cadmium plating for steel, brass, or bronze. Those used more rarely are tin and zinc plating. In the manufacture of airframes, chromium plating is the principal method used to obtain bearing surfaces which are smooth and hard. Other types of plating, such as indium, have found some use in motor manufacture but as yet have not been found adaptable to airframe construction. Copper is the material used for masking prior to selective carburizing. These treatments will be discussed in detail here with their special application in aircraft.

Anodizing

Anodizing, used almost exclusively on aluminum, is undoubtedly the most important single form of plating used in aircraft construction. This process consists for forming aluminum oxide on the surface of aluminum alloys by electrochemical means as a very thin but impervious film to aluminum oxide. This film prevents the further oxidation of the aluminum and forms an excellent base for paint.

It is interesting to note that anodizing represents practically 100% throwing power. This is explained by the fact that aluminum oxide is not a good electrical conductor. Consequently when, the corners get anodized first they no longer are con-

ductive. Those parts not yet affected still conduct current and hence will get anodized. This goes on until all areas are anodized.

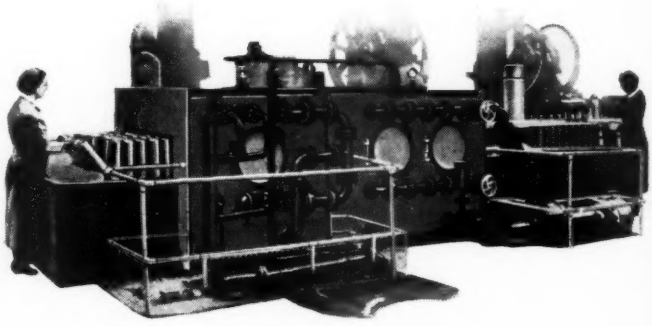
It is the statement of some that anodizing is not an electroplating operation but this idea is based on the definition of electroplating as the electrodeposition of a metal. However, the American Standards Association defines electroplating as "the process of depositing, by means of an electric current, any metal or other substance on a given object or objects." Since in this case, oxygen is deposited on the surface where it combines with the aluminum, anodizing can be interpreted as being an electroplating process.

The electrolyte used in anodic oxidation consists of 5% by weight solution of chromic acid in tap water. It is necessary, however, to limit the amount of chlorides and sulphates in order to obtain a good anodic coat. The bath is operated at 95° F. and is controlled within $\pm$ 4° F. Many organizations have varied these figures and claim better results. However, the above procedure is standard and has been shown to give satisfactory and reliable coatings. The voltage used, is, unfortunately, 40 volts instead of the standard plating voltages. Normal current densities are of the order of 1-1/2 to 2 amps. sq. ft. Thirty minutes is the standard time for the anodizing treatment. These are the highlights of anodizing by the chromic acid method. Sulphuric acid is also used as an electrolyte in the commercial process of "alumiliting."* This process is limited in use due to the fact that it is a patented process and that is not allowed by Army-Navy specifications on completed assemblies but it may be used on detail parts. Alumiliting is used extensively in commercial practice as a method of coloring aluminum alloys.

* Trade-mark registered U. S. Patent Office by Aluminum Company of America. 1—Which are subject to stress and which contain joints or recesses in which the anodizing solution may be retained,

Cleaning Before Anodizing

Anodizing does not require the high standard of cleaning that most electroplating processes demand. However, parts which are excessively oily or greasy are usually cleaned in an alkaline cleaner especially designed for cleaning aluminum. Ordinary



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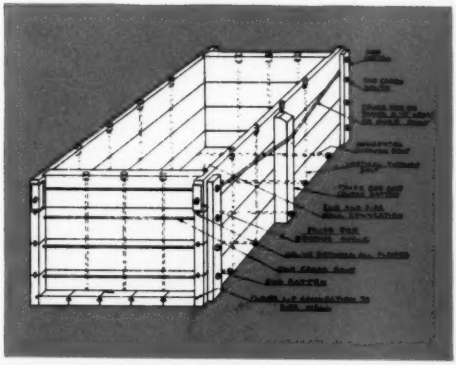
ve steel, speed delivery. Made of best ty kiln dried cypress or redwood with oak orcing battens at ends, H-VW-M Wood s may be furnished unlined, lead lined phaltum lined. 2" lumber is used for up to 6' long, 3" lumber for tanks up ' long. Wrought iron tie rods, bolts, and washers are standard.

altum used for lining is of a special , not affected by plating solutions below Excellent for nickel, copper sulphate inc sulphate baths.

eams on lead lined tanks are burned in. used is 1/8" thick but 3/16" or 1/4" be supplied. Withstands higher tem- ures than asphaltum lining.



ndard types of Anode Hooks designed for attachment to any size and shape of Anodes.

CONDUCTOR BAR SIZES ACCOMMODATED

O.	1	2	3	4	5	6	7
...	⅜" diam.	¾" diam.	¾" diam.	¾" diam.	1" diam.	1¼" diam.	½" diam.
M ...	1½" diam.	1¼" diam. & 1¼x3 rect.	1½" diam.	1½" diam. & 1¼x3 rect.	1½" diam.	2" diam.	1" diam. x 2½ rect.
.....	4¾"	5¼"	4¾"	5¼"	4¾"	5⅝"	6½"

LEAD ANODES OF ALL TYPES AND SIZES

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electroplating and polishing equipment and supplies

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2789

plating cleaners cannot be used on aluminum because of their tendency toward etching. Consequently milder cleaners must be used. Occasionally precleaners of the solvent type are used to prevent excessive contamination of alkaline cleaning bath. This is usually not warranted, however, due to the low cost of cleaners of the alkaline type.

Anodizing Substitutions

In recent years the use of anodizing has decreased markedly, largely due to the more prevalent use of "Alclad" material and to the development of substitute methods such as "chromadizing" and the "Alrok"* process. Alclad consists of a high strength aluminum alloy sandwiched between two layers of commercially pure aluminum. These outside layers, each about 5% of the total thickness of the sheet, protect the stronger alloy electrochemically. Chromadizing (or chromatizing) is essentially anodizing without electric current with the exception that a higher temperature (140° F.) and a shorter time (5 minutes) are used. Parts must be considerably cleaner when they are to be chromatized than if they are to be anodized. However, the same type of cleaner is used. Chromatizing, while forming a good base for paint, is of little value when not painted. Chromatizing, like most substitutes, is not as good as anodizing but on land based airplanes is usually adequate and it represents a considerably cheaper and quicker method where the demands are not too critical. The "Alrok" process consists of an oxidation process giving results similar to chromatizing. The procedure involves immersion in a near boiling solution of sodium carbonate and potassium dichromate for a period of 30 minutes followed by a sealing treatment in a hot 5% potassium dichromate solution. "Alrok" is a patented process and has not found any great acceptance in aircraft work.

*Trade-mark registered U. S. Patent Office by Aluminum Company of America.

Inspection of Anodized Coatings

An anodized coat, when obtained by the chromic acid process, is a grey color and shows the grain structure of the base metal. It is non-conductive to electricity which provides a quick method for determining whether or not a part has been anodized by making an electrical conductivity check using an ordinary light bulb

in series with the aluminum alloy under test and the source of electric light power.

To determine whether a satisfactory coating has been applied, the standard test is a 20% salt spray solution operating at 95° F. for 250 hours. For the material to be satisfactory it must not show more than a 5% reduction in tensile strength or a 10% reduction in elongation at the end of this period.

Inspection by Anodizing

The ability of anodizing to accentuate cracks in the base metal is used as a method for the inspection of aluminum forgings. A large amount of work has been done to find a simpler and easier method, and while some of these have been adopted, none seem to work quite as well as anodizing. This is largely due to the fact that the chromic acid solution tends to permeate into the crack. When the part is subsequently ground to remove this crack it is possible to see the indication until it has been completely removed. This is a great advantage since otherwise the part would have to be retreated at least once during the grinding operation in order to be certain that all cracks were completely ground out.

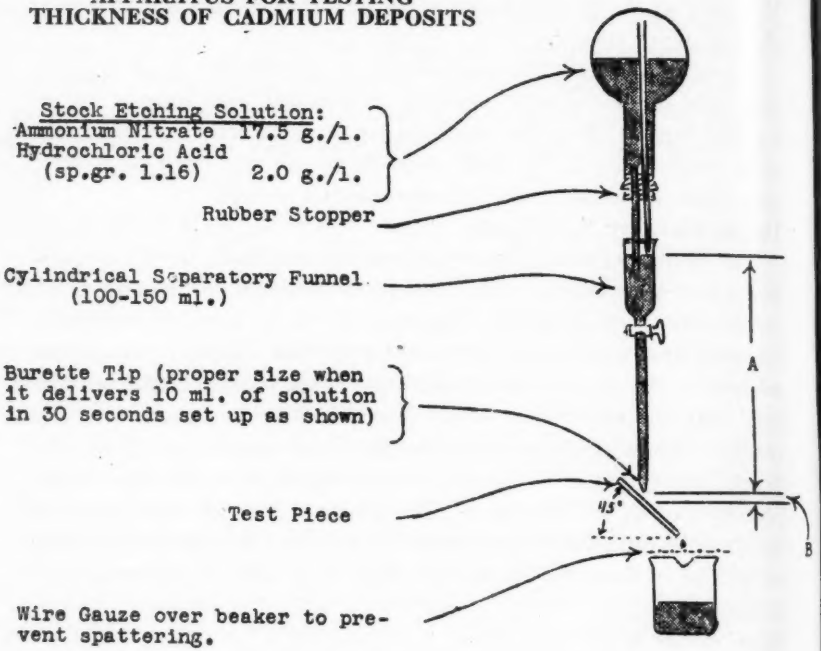
Size of Parts

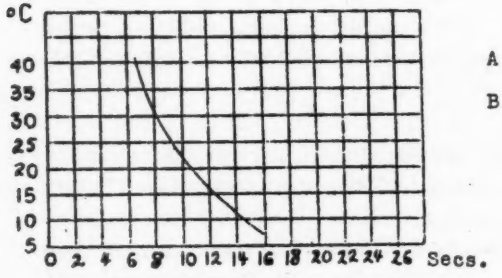
Parts to be anodized may vary from very small detail parts to very large subassemblies. Normally aircraft anodizing tanks vary from 20 to 35 feet long and are 5 to 6 feet deep with a width of 3 to 5 feet.

Cadmium Plating

Steel is protected almost universally in aircraft construction by means of cadmium plating. Cadmium was chosen after many tests had been run to determine the material most satisfactory for corrosion resistance. There has been much discussion from time to time as to the relative protective powers of cadmium and zinc plate. Cadmium was found to have a higher resistance to corrosion by salt spray water than zinc coatings could provide. This is largely due to the fact that zinc chloride forms very readily from the bare zinc. In other atmospheres zinc has often been found superior to cadmium, probably for the reason that zinc will provide electrolytic protection over a larger area. One very neat method for showing this is to take two ordinary steel washers and put into the hole of one, a zinc plug, and into the hole of the other put a cadmium plug. Under

APPARATUS FOR TESTING THICKNESS OF CADMIUM DEPOSITS


Stock Etching Solution:
Ammonium Nitrate 17.5 g./l.
Hydrochloric Acid (sp.gr. 1.16) 2.0 g./l.
Rubber Stopper
Cylindrical Separatory Funnel (100-150 ml.)
Burette Tip (proper size when it delivers 10 ml. of solution in 30 seconds set up as shown)
Test Piece
Wire Gauze over beaker to prevent spattering.
A
B
45°



Time-Temperature Relation For Penetration of 0.0001 Inch (0.0025 mm.) of Deposited Cadmium.

A = hydrostatic head of 10 inches
B = distance from burette tip to test specimen of 1/4 inch

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normal conditions it will be found that both the cadmium and the zinc will corrode away leaving the steel relatively unaffected. Now, if the size of the washer is increased until the edges are no longer protected by the plug, it will be found that zinc will protect a larger washer than will cadmium. The principal advantage of cadmium is that it forms a relatively impervious coating

which is not much subject to atmospheric attack whereas the zinc is quite active and tends to corrode away, particularly on seashore exposures, finally leaving the base metal unprotected. Cadmium is applied in the aircraft industry in a standard cyanide bath. Since this is a standard procedure I will not go into the details of the bath or plating procedure.

Commercial practice has shown that coatings of 4 to 5 ten thousandths of an inch are the most economical for outside exposure. Both the Army and Navy specify the lower limit of 5 ten thousandths for all parts inside or outside the airplane except for externally threaded parts for which two ten thousandths is specified, since under-cutting of threads is not allowed. Normal procedure for testing the thickness of the plate is by the drop test. (See attached illustration.) In this test the solution is allowed to drip onto the part at a specified rate and at a specified angle. By timing the period it takes for the test solution to eat through the plate the thickness can be determined. This test provides a quick and relatively accurate method for determining the thickness because a two ten thousandths inch plate will be eaten away in twenty seconds, each second representing one one hundred thousandth of an inch. The objections to this method are two-fold—first, it destroys the plate and second, the end point is somewhat difficult to determine. The only important cause for rejection of cadmium plated parts is on the basis of inadequate thickness of plate. Each batch of material is checked for thickness, by the drop test previously mentioned, upon arrival at the aircraft manufacturer's plant so that it behooves the sub-contractor to make sure of his plating thickness before submitting his parts to the purchaser.

Army-Navy specifications require that no undercoating of any kind be used before cadmium plating. This is usually well understood by the plater and does not provide more than an isolated case of trouble. Occasional cases have recently been found where the copper plate used for selective casehardening was not removed before cadmium plating. This was discovered when the parts began to corrode. It is important therefore that no undercoats be used.

Ordinarily steel fittings of relatively small size constitute most of the cadmium plating requirements although some welded assemblies, including entire fuselage frames, are cadmium plated

by some manufacturers. Tanks are usually 6 to 8 feet long*. Of course for larger welded assemblies larger tanks must be used. (*4 to 5 feet deep.)

Hard Chromium Plating

Chromium plating is much more of a problem than is cadmium. In this case thickness of plate is relatively inconsequential since it is not applied for the purpose of corrosion prevention but for the purpose of obtaining a hard smooth surface. Practically 100% of all aircraft chrome plating is "hard" rather than "decorative" chromium plate. In general chromium plating done outside of the aircraft plant has not been satisfactory for two reasons—(1) misunderstanding of plating problems by the aircraft designer and those responsible for preparing the base part for the plater; (2) by lack of understanding on the part of the plater for the rigid requirements demanded by airplane hydraulic parts. Critical aircraft hydraulic parts in general consist of a cylinder with a chrome plated operating piston and piston rod. The hydraulic fluid is prevented from leaking around the piston by means of rubber or synthetic rubber packings. Now these packings have a disgustingly short life particularly if the piston which rubs back and forth across these rubber packings is in the least bit rough. The rubber packings have to hold in pressures varying from 750 psi to a ton and a half per square inch. With these pressures the packing is forced very tightly against the piston rod in order to prevent leakage. This means that any slight irregularity in the piston, going back and forth over the surface of the packing, will result in excessive wear to the packing. This condition requires frequent replacement of packing and constitutes a serious hazard as many critical controls in the airplane, such as wingflaps and retractable landing gears are hydraulically operated. The need immediately becomes apparent for having a perfectly smooth plating job with no variation in diameter from spot to spot along the piston. Now all this makes it rather hard on the plater because the raw parts coming to him from the aircraft manufacturer will probably *not* be ready for plate. This condition is something which the industry has been trying to improve.

Before Plating

Nearly all hydraulic pistons are centerless ground before being delivered to the plater. Often the wheels used will be quite

coarse and the machining marks are quite apparent, especially after plating. Consequently, a large amount of polishing is necessary before plating takes place. These hydraulic parts, by the way, are usually "size" plating jobs. The general procedure in preparation is to use an abrasive wheel to take out the machining marks. Frequently it is advisable to use a 180 wheel followed by a 220 wheel. This is usually followed by a sewed buff using a cutting compound and then by a loose buff to give a high color. It is not anticipated that the aircraft company will ever provide the parts in such good condition that the last two steps can be avoided. By proper selection of centerless grinding wheels however, the use of the abrasive wheels can be eliminated. Often parts may come into the plater with nicks which were caused by rough handling. If the nicks are not deep they may be taken out. However, since everything is done by the airplane designer to reduce weight often these parts may be stressed to the legal limit. Therefore before removing deep nicks, the plater should get the approval of the aircraft manufacturer. Part drawings give the lower dimensional limits before plating. These should not be exceeded in removing nicks. Unless approval to remove the nicks can be obtained, such parts should be rejected by the plater. A good test for determining whether a part is sufficiently smooth for plating is to run your fingernail along it. In this way very minute scratches can be detected. If you can feel these scratches the part is not smooth enough. So much for the preparation of the part for plating.

Plating Procedure

Hard chrome plating as done in aircraft usually uses a standard 33 oz. per gallon solution of chromic acid with a chromic acid sulphuric acid ratio of 100:1. Of course, being hard chrome plate, no undercoats are allowed. Normal thickness of plate runs from 15 ten thousandths to 20 ten thousandths per surface or 3 to 4 thousandths on the diameter. For special applications this might run as high as 7 thousandths. The actual thickness of plate depends on whether the unplated part is on the high or the low side of its tolerance. Aircraft drawings specify the size before and after plating rather than specifying the thickness directly. Ordinary plating tolerances are in the order of $\pm$ 1 thousandth on the diameter of the part. Special applications of course require much closer tolerances. Details of bath and

actual plating procedure will not be discussed because, again, they are standard.

After Plating

Usually engineers will put on drawings simply "polish" or "light buff." Actually what they mean in almost all cases is polish, buff, and then give a high color. This source of confusion is being corrected by an educational program for the engineers. We are trying to standardize for all future drawings on "buff and color" for very smooth parts such as the hydraulic ones previously mentioned. The fingernail test applies to smoothness after plating also.

Aircraft parts to be chromium plated are usually cylinders which are plated on the outside only. The diameter of these tubes normally ranges from a fraction of an inch to two or three inches in diameter and may be as long as six feet.

Selective Casehardening

Often it is desirable to have a part which provides a hard wearing surface over only part of the material while the remainder is kept soft for increased toughness. This may be accomplished by "selective hardening" the surface by carburizing or similar means. The "stop-off" for this purpose is a good dense copper plate a few thousandths thick. This copper plate prevents the carbon from penetrating the surface of the steel at the plated areas and thereby keeping them soft. This method is in general use in industry including phases outside of aircraft.

Other Forms of Plating

Tin is used to a limited extent in the protection of steel rivets. Its principal advantage is that usage is its great flexibility which allows the rivet to be driven without destroying the plate.

Zinc plating has not been used to any extent as yet in airframe construction but during these war conditions, its use will probably increase due to the difficulty in obtaining cadmium. The fact that zinc plating is relatively cheap speaks also in its favor.

Conclusion

I have attempted to give to you some information as to the type of plating used in aircraft and how rigid the requirements are. It is my hope that this will enable us to reach a basis for mutual understanding of one another's problems to further the cause to victory.

Research Committee

The present Research was started to determine the effects of various methods of preparing a base metal for plating on the corrosion resistance of electrodeposits and plated coatings. The whole problem was broken down into two phases; first the effect of various methods of polishing and buffing of the base metal on the corrosion resistance of the electrodeposit and second the effect of pickling, degreasing, cleaning, etc. on the corrosion resistance of the coating. Up to now the first phase of the problem has been studied and the work on Steel is approaching completion. The work on Brass and Die Castings is following the work on Steel.

One of the first problems of the Research Associates was to find a method of evaluating polishes on base metals and to find a method of producing the same finish time after time with a minimum of variation. It was realized at the outset of the Research that the methods of polishing and the combination of grits would in many cases not be commercial but in order to determine the fundamental facts wide variations from commercial practices are usually necessary. Considerable time was spent studying the polishes produced with variations in pressure, methods of wheel set up, wheel speeds and grits to determine exactly the surface characteristics of the metal which were being produced. The surfaces were examined by the naked eye, by a microscope, with a profilometer and with a reflectometer. All of these methods were used in an effort to get all the comparisons possible between the various polishes. It was found that the profilometer and the microscope gave the best results and that for a rapid method of checking the profilometer was sufficiently accurate. The profilometer is an instrument that uses a very sharply pointed stylus which is drawn over the polished surface. The amount of up and down movement of this stylus is magnified sufficiently so that an easily useable figure is obtained as a measure of the depth of the scratches. It was felt that this figure along with the amount of metal removed gave sufficient data so that the results of the corrosion test could ultimately be correlated with the polishes.

The preliminary results of these methods of polishing have been given in the Annual Report of Mr. Lux, the former Research Associate of the American Electroplaters' Society, and it is hoped that they have been studied by all the Members. Very briefly several things were discovered during this work. First, the amount of metal removed in one polishing operation was greater than the depth of the scratches in the coarsest polish used and that it made no difference in the final surface characteristics whether the samples were polished in the same direction as the previous polish or were cross polished. Second, contrary to common conception of polishing, it was found that the amount of metal removed did not vary greatly with the size grain of the polishing wheel. Only the depth and width of the scratches decreased with a decrease in polishing grain size. Third, several facts which are common knowledge were confirmed such as the effect of lubrication of the polishing head on the effect of the polish and the effect of lubrication on the amount of loading of the head.

It is expected that by this time these results have been studied with the intent of applying them to commercial practice. We would be interested to hear of the results obtained in this work as we feel that the results should point out possible economies in commercial polishing practice.

E. T. CANDEE.

Business and Social News

BRANCH NEWS

Educational Activities

AMERICAN ELECTROPLATERS' SOCIETY

New Haven Branch held its last business meeting of the year 1942 in the Sterling Chemistry laboratory of Yale University on May 5th. The meeting was called to order by President Joseph Sullivan promptly at 8:30.

The main business taken up at this meeting was the election of new officers for the coming year. As the rotation of officers has been the practice in the New Haven branch since its inception, then two of the offices, namely president and vice-president were filled by "Doc" Garner, elevated from V.P. and Ed Luther, elevated from S.T. Because of the pressure of business and necessary travel connected with his position, Jack Harper asked not to be considered for a higher office. In his place Walter Lynch was elected to the position of secretary-treasurer, and then Kay Jaris of Waterbury was elected to the assistant secretary-treasurer's position.

As has been the practice in the past years, the retiring president, Mr. Joseph Sullivan, automatically became a member of the board of governors. In this position Mr. Sullivan joined three of the older original members of the branch, namely, Mr. George Knecht, Mr. Henry Smith, and Mr. Albert Rosenthal.

After the election of officers a discussion was started to find out how the members felt regarding a program for next year. Because the New Haven branch is made up of members coming from various other cities like Waterbury, Bridgeport, and Hartford, then the gasoline and tire problem becomes very acute. Various suggestions were made by the members, which may be summarized in the belief that open meetings which are held once a month will be about all the members will be able to support. These open meetings may be either preceded by the business meetings whenever the officers think it is necessary, or else the business meetings will be held on the Tuesday during the month which the president designates.

The members then decided to allow the newly elected officers to decide what should be done about an educational program for next year. As the New Haven Branch was one of the forerunners in conducting educational sessions, the officers intend to do their best to set up some form of program in spite of the many adverse conditions in the way.

WALTER LYNCH, *Secy.*

Newark Branch, A.E.S., held its regular meeting on Friday evening, June 19, 1942 at the Hotel Robert Treat, Newark, N. J. The meeting was called to order at 8:45 P.M. with President Wm. Bruhns in the chair and all other officers present.

The minutes of the previous meeting were read and approved.

A request from Mr. John Yarmack for his resignation was granted and the Secretary was instructed to answer his letter informing him to this effect.

A communication from Louis Maine who is now a 2nd Lt. C.W.S. in the U.S. Army was read and the Secretary stated that he had already answered him informing him that during the

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term of his service his dues would be omitted.

Mr. Fred Manazzo and Mr. Samuel Martorana were elected to Associate Membership. Mr. Fred Hurst was reinstated to Associate Membership.

Mr. Horace Smith, one of the Convention Delegates, announced that our Secretary, George Wagner, was elected to the office of 1st Vice-President and stated that as such he should have the honor of making the report of the Convention Delegates. George then gave a detailed report of the Convention, for which the members gave him a hearty round of applause. Mr. John Lavery, the third delegate, supplemented this report by adding a few more details.

Mr. Smith next suggested that Newark Branch create a fund for our next Convention and asked the members to deposit their money with the Secretary who would keep a separate account for each member contributing. This suggestion was received by the members with great enthusiasm and a few of them started the fund immediately.

It was next suggested that the Secretary communicate with the members in the Armed Forces and send them gifts, etc., out of the Branch funds.

Meeting adjourned at 10:30 P.M.

GEORGE WAGNER, *Secy.*

Milwaukee Branch of the American Electroplaters' Society held its 331st regular meeting at the Republican Hotel, June 5, 1942. The meeting was called to order at 8 o'clock by President Rodney Olsen. All officers were present. Minutes of the previous meeting were read and approved.

The meeting continued with discussion of the surprise meeting to be held at Nagawicka Lake, July 17, for Joe Birbaum who has been a member since 1913. The details were left to Harry Unke and secretary. A committee being appointed to help them.

Librarian William Geissman reported that a few copies of the REVIEW are still missing from the collection for the Milwaukee Public Library. The members then talked about old REVEIW, revealing that many of the older members had complete files beginning when the Milwaukee Branch was chartered.

Robert Steuernagel Sr. proposed that we suspend our July and August meetings. The motion was seconded by Al Hermansen and carried by the members present.

William Geissman reported that he and Phil Ritzenthaler had met with the Apprenticeship Division of the State Industrial Commission and agreed to let Mr. Hoffman of the Commission

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try and sell the idea of apprenticeship to the manufacturers. They stated that a satisfactory program for study and work of apprenticeships had been planned. Mr. Robert Steuenagel Sr. said that Mr. Hoffman was doing his part in selling the idea to the manufacturers, and a general forum followed favoring the much discussed apprenticeship program.

The meeting was then turned over to William Geissman who gave an interesting resume on "Health and Work Hazards in the Plating Rooms." His talk and the comments from other members that followed covered many interesting cases and rules governed by the Industrial Commission. He also reviewed some of the rules and orders on health and sanitation that have become overlooked in some shops.

There being no further business, the meeting adjourned at 10:15.

JAMES DURNFORD, *Secy.*

Chicago Branch held its regular monthly meeting on Friday, July 10, 1942 at the Atlantic Hotel.

President F. K. Savage presiding and all other officers present.

The applications of C. E. Long and R. W. Littlejohn read and committees appointed on same.

Mr. E. S. Johnson and Mr. M. S. Schneider were elected to associate membership. Mr. J. J. Vallone was elected to active membership.

Mr. E. A. Lanz reported the death of one of our charter members of Chicago Branch, Mr. H. Magnus, Chicago Branch regrets that they did not know of this sooner and wishes to extend their deepest sympathy to Mr. Magnus' family.

The delegates report of the Grand Rapids convention by J. W. Hanlon and M. H. Longfield was read and placed on file.

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A motion was made, seconded and passed that Chicago Branch donate $100.00 to the research fund.

President Savage stated that Mr. C. M. Iwen would be the guest librarian at this meeting and also appointed Mr. J. A. Raskin, Mr. L. C. Borchert, Mr. O. Weickmann and Mr. E. A. Lanz as a committee to help answer some of the questions that were asked in the question box.

Mr. Iwen introduced the guest speaker of the evening, Mr. J. A. Raskin of the Udylite Co. who spoke on "Cadmium Plating for War Production." This proved to be a very timely, interesting and instructive talk, and the prompt way Mr. Raskin answered the questions asked proved that he was the master of his subject.

There were 90 in attendance at this meeting which is a record for a hot evening in July and the meeting adjourned at 10:45 P.M.

At a meeting of the Board of Managers the secretary received permission to buy $700.00 worth more of War Bonds.

J. W. HANLON, *Secy.*

Indianapolis Branch meeting of June 3, 1942. The meeting, opened by self-introduction of the members present, was conducted by Vice-Pres. Fisher in the absence of Pres. Hennessy, who was called away abruptly. Reports of the Secretary and Treasurer were read and accepted. The Secretary was instructed to issue a letter of identification to the delegates to the National Convention. Vice-President Fisher read his report of last year's branch activities.

Branch Librarian, Walter R. Binai introduced the speaker of the evening, Mr. R. M. Wagner, Chief Metallurgist of the Guide Lamp Divsion, M. M. C. Mr. Wagner spoke in an interesting fashion of some of the transitions and developments in the field of electroplating. Subjects mentioned in his talk included: Chrome plating, Zinc and cadmium plating, Low pH nickel plating, Bright nickel—Schlotter patents. Plating on aluminum by use of an anodic film, and Anodizing itself, Bright zinc and cadmium, Rochelle salt copper plating, Hi-speed copper and brass plating.

Development of cleaning—vapor degreasers, emulsion cleaning, spray cleaning (pre-cleaning), and anodic cleaning. Relative to alkali cleaning, he mentioned the fact that the pH is not the controlling factor; the conductivity increases greatly from 180 degrees F. to 205 degrees F., whereas the pH drops off in this temperature range.

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ment of Geo. B. Hogaboom, was mentioned.

The Corronizing process, where a thin coat of nickel is alloyed with a thin coat of zinc by the application of heat after plating, was mentioned. A present-day improvement of this process is the deposition of zinc and nickel together as an alloy, which gives remarkable corrosion resistance with a very thin deposit.

A new bright copper bath, based on the standard acid copper solution, has been developed by W. M. Phillips.

A new zinc plating process, designed to use low-grade zinc ore and by-products upon which there is no priority, has been developed. This process involves the use of carbon anodes and zinc salt briquettes, and the plate is produced by direct current with superimposed alternating current. Thus, polarization is overcome completely and a deposition rate 4 times normal is obtained.

Zinc plate can be dipped in a dichromate solution to increase the corosion resistance 4 or 5 times.

Shuline process of immersing zinc plate in chromic acid, using alternating current, produces a black film very resistant to corrosion.

The various blacks on steel, Parkerizing, Lubrizing, and the caustic soda blacks, were mentioned.

Vice-Pres. Fisher thanked Mr. R. M. Wagner for his efforts, and the meeting adjourned at 10:05 P.M.

EZRA A. BLOUCT, *Secy.*

Bridgeport Branch of the American Electroplaters' Society held its regular monthly meeting on Friday, June 5, 1942 at 8:00 P.M. at the Stratfield Hotel. President Charles McElroy opened the meeting with twenty-four members present.

The roll call of officers was read and all were reported present. The minutes of the previous meeting were read and accepted.

Reports of Special Committees:

The Regional Meeting Committee have concluded their affair and will have a complete report at the next meeting.

Reports of Standing Committees:

Dr. Walter R. Meyer was reported sick and is doing well at the hospital. The Branch is in sympathy with Dr. Meyer and is hoping for his complete recovery from his illness. Librarian Clarence C. Helmle was delegated by the Branch to visit Dr. Meyer at the hospital and cheer him up for more round table discussions.

Reports of Membership Committee:

The Membership Chairman, R. J. O'Connor, through the Committee

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Communications:

A letter from the United War Fund was read and received with complete enthusiasm by the Branch. The members individually have pledged and given to this fine request. The letter was then ordered to be placed on file.

A letter from H. G. Zucker, 195 Placid Ave., Stratford, Conn., in which he expressed a desire to resign from the Branch due to leaving Bridgeport and a change in business. This request was complied with.

Applications for Membership:

Carleton H. Deuter, General Electric Co., Bridgeport, Associate member, and Eugene P. Schimmel, Bassick Co., Bridgeport Associate member.

Balloting for Membership:

Raymond J. Kwasnik, Contract Plating Co., Stratford Conn., Associate member.

Unfinished Business: None.

New Business:

A motion was made and passed that the registration fees to the convention is to be paid by the Branch to all the officers and delegates who attend the convention in Grand Rapids, Michigan.

A motion was made and passed to suspend meetings during the months of July and August, 1942.

A motion was made and passed to hold an outing in September to include both men and the ladies.

President Charles McElroy appointed the following members as Committee for this outing: Arthur R. McNeil, Chairman, Raymond J. Kwasnik, William Ehrencrona, Charles McElroy, Joseph G. Sterling.

Raymond J. O'Connor, 2nd vice president, and Chairman of the Membership Committee has appointed the following members to the Membership Committee: Frank J. Kalafus, William Ehrencrona, Hubert Goldman, Eugene Phillips.

Bills against the Branch: None.

Good of the Order: No comments.

The treasurers report was read and accepted.

President Charles McElroy turned the meeting over to R. J. O'Connor who presided as Educational Chairman in the absence of Clarence C. Helmle who was away due to business. A thorough discussion was held on hard chrome plating, anodizing and Parkerizing, and considerable information came to light in the exchange of information which followed.

The meeting adjourned at 11:00 P.M.

JOSEPH G. STERLING, *Secy.*

Milwaukee Branch. July 17th, 1942, found the members at Nagawicka Lake paying special honors to Mr. Joseph Birbaum in a surprise visit en masse. Mr. Birbaum, an active Milwaukee Branch member since 1913, was delighted to think the meeting would come to him as he has been unable to attend some of the meetings.

The members enjoyed themselves swimming, fishing, and playing cards. Mr. Birbaum displayed his fishing

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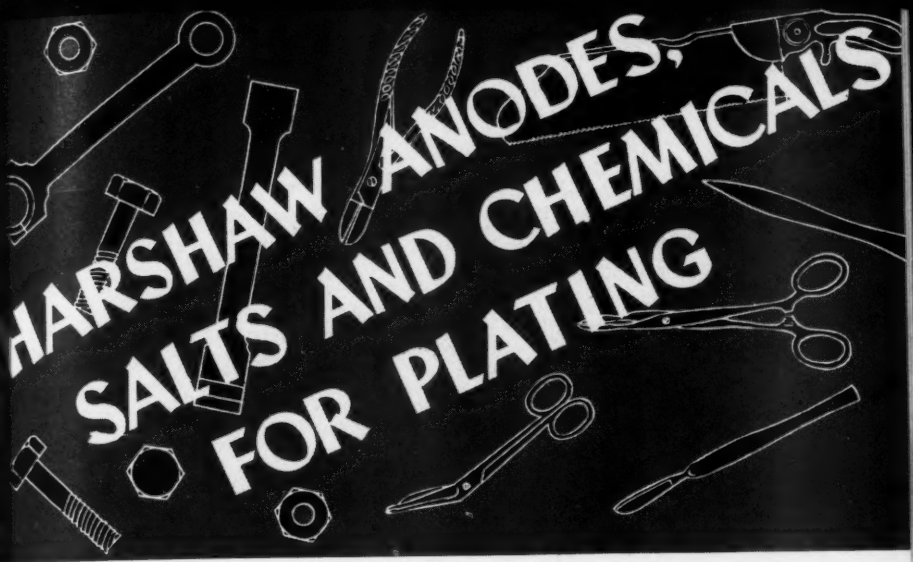

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abilities through moving pictures taken on his trip to Canada. The movies were very interesting, showing some unusal shots of a log jam and how it was broken up; and since the films were in technicolor, the scenes were as vivid and picturesque as the country itself.

As the evening progressed, the older members reminisced about earlier meetings and doings of Milwaukee Branch. Mr. Dan Wittig talked of the days when the branch gathered to discuss ways and means of making progress in plating and the times when collecting dues was the biggest job in the society. He told of how the pool tables and bar at the meeting place attracted the members for a big part of the evening and how they managed to grow and play an important part in the history of plating in spite of the pool tables and bar. Telling a few tales about some of the members of those days, he concluded with a word of praise for the men who have helped make the Milwaukee Branch a success and stood by it through the years. Although Mr. Wittig didn't list any men in particular, such men as Joseph Birbaum, Robert Steurnagel Sr., E. Jaeger, Joseph Bykouski, John Andryske, Andrew Kraft, and John Miszewski Sr., were among those present back in 1913 and still are members of the branch.

Mr. Robert Steurnagel Sr. recalled the days when he and Mr. Birbaum worked together. Mr. Birbaum remembered how men in those days all believed each had the best methods of plating and were quite secretive about it; another reason, was that they didn't want the others to find out how little they really did know.

The evening ended with thanks to Mrs. Birbaum for preparing the lunch and expressions of a grand time had by all. JAMES DURNFORD, *Secy.*

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THE QUESTION BOX

Chicago Question Box

1. *What causes copper anodes in an acid copper solution to sludge when they are air agitated, they are all right when not agitated?*

Ans. In this case the air agitation should be increased.

2. *At what concentration of Aluminum must a chromic acid anodizing solution be discarded, and what about the chlorides?*

Ans. Discard solution at about 10% the chlorides should be kept as low as possible.

3. *How explosive is a 15% perchloric acid solution 15 volume HjOj?*

Ans. It is very explosive and is not recommended for use. It should not be heated.

4. *Wanted a good adherent black on a brass casting made in a plaster of paris mold, the milled surfaces on the casting take a nice black nickel, the parts that are not machined do not take an adherent deposit?*

Ans. Several suggestions offered but advised to pickle, bright dip and plate with low current in a muriatic acid, arsenic and iron filings solution. Steel anodes with this solution will give an adherent deposit.

5. *Is the salt spray test on nickel plated die castings of real value, or just a porous test that is of doubtful value, as to the wear or life of the plate?*

Ans. The salt spray test is a good indicator but should not be final as the thickness of the plate is a more accurate test.

6. *What type of pickle can be used on steel that has been welded to remove the welding flux?*

Ans. Several suggestions offered but thought that sand blasting, or shot blasting would be best in this case.

7. *What causes blistering also pitting on cadmium deposits?*

Ans. Impurities cause blistering, pitting is caused by many things such as poor cleaning, impurities and roughness, the solution should be kept clean and it may be necessary to filter and bag the anodes. J. W. HANLON, *Secy.*

Indianapolis Question Box

1. *How can a nitrided surface be cadmium-plated?*

Ans. Allow a rust film to form and plate the parts in a barrel plater while still rusty. Drive off hydrogen in hot water afterwards.

2. *What is the best way to strip nickel from iron?*

Ans. Use concentrated nitric acid dip, or sodium nitride (4 lb./pH 6.8-7.2) with high current density reverse current, or concentrated sulphuric acid with reverse current.

3. *How can aluminum be protected from anodizing?*

Ans. Use rubber mask or stop-off lacquer.

4. *What is the proper way to silver plate directly on sheet zinc?*

Ans. Silver strike in a solution high in cyanide (130 gm./liter) and low in silver (¼ oz./gal.). Zinc should be connected to the cathode on entering solution.

5. *How can good adherence of nickel direct on steel be obtained?*

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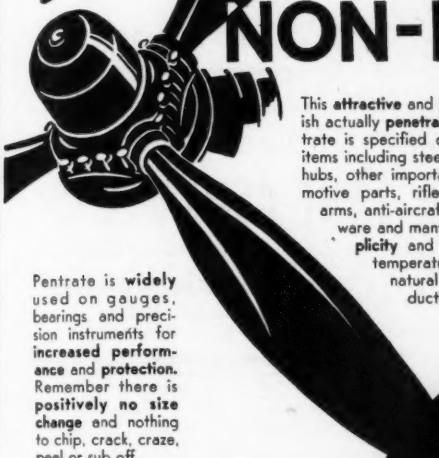

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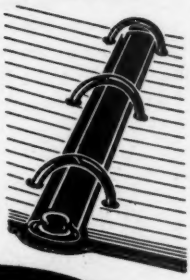

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Ans. Use proper and thorough cleaning, acid dip, then go direct to nickel solution. Dull nickel sticks better than bright nickel. Carbon smut on steel may be causing the trouble. Try making the steel the cathode in 7% sulphuric acid.

6. *How can bright tin be produced?*

Ans. Keep free caustic under 2 oz./gal. to get a white tin. Dip tin plate in an oil bath at 350 deg. F. to brighten the deposit. Analyze sodium stannate for caustic—sometimes it contains 40% free caustic. must be neutralized with acetic acid in tin bath.

7. *How can lead be stripped from copper or steel?*

Ans. By fuming nitric acid, or in a hot solution of sodium cyanide (strong) to which has been added rochelle salt.

8. *Can a better bond be produced on polished or rough surface?*

Ans. Best bond produced on polished surface.

9. *What is a practical method of removing scale from lead anodes used in chrome bath?*

Ans. Brush by hand with stiff wire brush.

10. *What causes flaking of hard chrome plate?*

Ans. Not caused by solution concentration, but by unequal temperature of the solution and the work. Either low or high current density should be used depending upon the nature of the work.

11. *What causes chrome to peel when the peeled spot shows that chrome has peeled from chrome?*

Ans. The current density might have been too high.

12. *What is the effect of sodium hexametaphosphate (Calgon water softener) on a plating solution?*

Ans. Pure water is best. This softener would be O.K. for a cyanide solution, but bad for a nickel solution.

13. *Can aluminum be darkened in a black nickel solution?*

Ans. Not directly; it is etched.

14. *What current density is used in the iron chloride plating solution?*

Ans. 60 amps./sq. ft.

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The Abstract Section

GEORGE WAGNER, *Chairman, Program and Educational Committee*

Electrodeposition of the Metals of the Platinum group. By K. SCHUMPELT. *Trans. Electrochemical Society* **80** (Paper 40) (1941). Platinum is deposited mostly as a white, non-tarnishing "flash plate" for ornamental purposes, over a nickel undercoat or directly on white gold jewelry; if the word *platinum* appears in the hallmark, the deposit must amount to 5% by weight of the article. Rhodium is used similarly, and heavier coatings are applied to silverware, reflectors for searchlights, motion picture projectors, etc. The use of complex salts of the metals is perhaps responsible for the good throwing power of these acid baths. For platinum, an amino-phosphate bath which has been much used is described, but the following bath is said to be superior:

	g./1.	*oz./gal.*
Platinum diamino nitrite, $Pt(NH_3)_2(NO_2)_2$ (dissolved in 5% ammonia to form $Pt(NH_3)_4(NO_2)_2$)	16.5	2.2
Sodium nitrite, $NaNO_2$	10	1.3
Ammonium nitrate, NH_4NO_3	100	13.4
Ammonia, NH_4OH (28% solution)	50	6.7

The bath is operated near the boiling point, and requires replenishment of the ammonia lost by evaporation. The pH is 6.4-7.0. Flash plates are obtained in 30-60 sec. at 4-5 v. For heavier deposits, a current density of 4.1 amp./sq. ft. at about 2.4 v. is recommended; the plate is hard, and must be scratch brushed intermittently. Since the platinum anodes are insoluble, metal is replenished by additions of the platinum salt. Because the cathode efficiency varies widely, articles are weighed from time to time to determine the amount of deposit. Although palladium plating has not yet found industrial application, it offers advantages as to price and specific gravity; a bath is described. Rhodium, though more costly than platinum, gives brilliant blue-white deposits, intermediate between nickel and chromium in hardness, and reflecting 78% of the incident light. Baths are easily operated and have excellent throwing power. They are made by adding a "prepared concentrated solution" of rhodium as a complex phosphate to solutions of sulfuric or phosphoric acid. A current density of 10-100 amp./sq. ft. is used at 110-125°F. Anodes are of platinum; rhodium is replenished by adding the prepared concentrated solution. A bright deposit 0.00006″ thick is produced in 30 min. at 20 amp./sq. ft. which does not require buffing. Except on gold and platinum, a nickel undercoat is customary; it must be heavy on zinc, tin, and lead alloys. Data are given on the effect of temperature, current density, and rhodium concentration on cathode efficiency. A colorimetric method of analysis is available. Flash plates are less than 0.000001″ thick; on silverware and high-grade reflectors, 0.0000075″ is recommended. A bath is given for ruthenium plating, but none are mentioned for osmium or iridium.

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New Work on Tin Plating from Ammonium Stannous Oxalate. By FRANK C. MATHERS and PAUL H. JOHNSON. *Trans. Electrochemical Soc.* **81,** (preprint 7) (1942). Excellent tin deposits have previously been obtained from the ammonium stannous oxalate bath using peptone as an addition agent, but the bath gradually deteriorated and could not be regenerated. A number of new addition agents have been tested, and "hydrolyzed glue" is recommended, prepared by boiling 10 g. of animal glue in 100 ml. water for 10 hours. The deposit was gray, smooth, and adherent. The cathode current density could be as high as 25 amp./sq. ft., but the anode current density must be lower (3.5 amp./sq. ft.). The bath gradually deteriorates and deposits black, loosely adherent tin. It was found that this is due to oxidation of the stannous oxalate to stannic salts at the anode. The bath was easily regenerated by boiling with spongy tin. The formula recommended is:

Ammonium oxalate	8 oz./gal.
Stannous oxalate	6.5 oz./gal.
Oxalic acid	2 oz./gal.
Potassium iodide	6.5 oz./gal.
Hydrolyzed glue	0.13 oz./gal.
Pyrogallol	0.13 oz./gal.

The iodide and pyrogallol are not essential, but improve the deposit somewhat. Room temperature is recommended.

ERNEST H. LYONS, JR.

The Electrolytic Polishing of Silver. By L. I. GILBERTSON and OTIS M. FORTNER. *Trans. Electrochemical Society* **81** (preprint 5) (1942). Silver may be electropolished in the customary silver plating bath, with careful regulation of the (anodic) current density. The reflectivity obtained equals or surpasses that of mechanically polished silver. Necessary data for operation are presented. The process is suited for polishing small, irregularly shaped objects, or for preparing specimens for microscopic examination. The polishing effect is associated with the periodic formation and dissolution of an anode film. When silver dissolves from the anode too fast for the maintenance of a supply of sufficient cyanide at the anode surface to form the soluble silver cyanide complex, then the metal precipitates on the anode as a film of insoluble silver cyanide, which is a poor conductor. Projections rising above this film receive most of the current and are dissolved and leveled. When the entire surface is covered, the flow of current is substantially stopped, and electrolytic action ceases. Fresh cyanide diffusing in from the bath then dissolves the film and gives a fresh silver surface. The cycle is then repeated. Prior to dissolution, the film appears to hydrolyze to silver oxide. Photomicrographs of several stages of the polishing are included.

ERNEST H. LYONS, JR.

The Deposition Potentials of Cobalt, Nickel, and Copper from Chloride and Bromide Solutions. By RALPH VERDIECK, SISTER MARY JOECILE KSYCKI, and L. F. YNTEMA. *Trans. Electrochemical Society* **80** (Preprint 11) (1941). Nickel and cobalt deposit by immersion on copper from solutions of the chlorides and bromides; if the copper is smooth, the deposits are smooth and adherent. This study of the deposition po-

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tentials show the effect of adding magnesium chloride or bromide (up to 46 oz./gal., or 9 mol %) to form the corresponding complex ions of the metals. This effect is relatively small (as would be expected from the instability of the complex ions). Nickel was deposited as a non-adherent powder when the chloride concentration was low. The deposit became a smooth, adherent plate when the magnesium chloride exceeded about 10 oz./gal. (2 mol %) if the current density was low; however, above about 7 amp./sq. ft., the cathode gassed and the deposit was black and amorphous (as would be expected, since the nickel content was only about 2.1 oz./gal. (0.5 mol % $NiCl_2$), much less than in plating baths). With copper, no metal was deposited until the current density exceeded 11 amp./sq. ft. with 5.1 oz./gal. (1 mol %) $MgCl_2$, or 3.7 amp./sq. ft. with 31 oz./gal. (6 mol %) $MgCl_2$; below these current densities, cupric ion was reduced to cuprous, and sometimes there was an insoluble salt (cuprous chloride) precipitated at the cathode; at higher current densities, bright copper plate was deposited. The reduction of cupric ion is favored (i.e., lower potential) by high concentrations of the halide (as would be expected from the stability of the cuprous complex ions); likewise, the reduction is more favored by bromide than chloride (since the bromide complex is more stable). High temperatures favored the deposition of cobalt and nickel, but the deposition of copper was repressed; this was confirmed by noting that a solution of 4.7 oz./gal. (0.5 mol %) $NiCl_2$ with 46 oz./gal. (9 mol %) $MgCl_2$ deposited nickel on a copper sheet on immersion when hot, but not when cold.

ERNEST H. LYONS, JR.

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SUNDAY, SEPTEMBER 13, 1942
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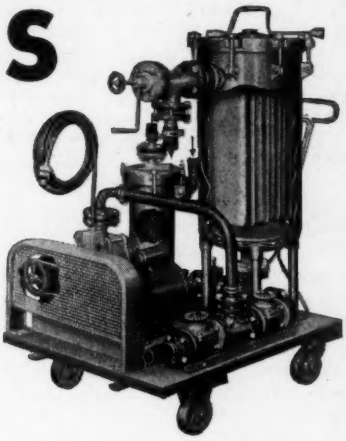

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LOS ANGELES BRANCH PICNIC

The Los Angeles Branch held its fourth annual picnic at Montebello Park, July 26th. The weather was ideal for such an affair and there was a very good turn out.

Among the first to arrive was Mr. and Mrs. John Merigold and John didn't forget the lunch this year. You will recall that last year they were in such a rush to get there and being late to start, John left the lunch sitting on the sink. Who ever heard of coming to a picnic without a lunch?

Then there was Marcus and Mrs. Rynkofs with their sons, daughters and grandchildren. Marcus said he held about an AA rating on grandchildren, having about eight in stock, and with that rating he has nothing to worry about.

Mr. and Mrs. Clarence Thornton arrived a little late. In fact too late for yours truly to have some of the luscious pie that is always present. Fried chicken seemed to be outstanding on most tables.

Cold drinks and ice cream was furnished by Turco Products Co. which everyone enjoyed very much.

The picnic committee consisting of Chairman Ervin Frauenhoff, E. Wells, Stanley Rynkofs, John Merigold, E. R. Holman and C. C. McLaren were congratulated on the splendid way they handled everything.

After lunch and the ladies were repacking the baskets and the men were getting some verbal plating done which is always the case when two or more platers get together, the committee were getting things ready for games and races which were as follows:

50 yard race for girls up to 10 yrs. Barbara Ann Sloan first, Louise Biederman second, and Joan Wells third.

50 yard race for boys. Guy Biederman first, John Wilms second, and Buddy Frauenhoff third.

Womens shoe kicking contest. Mrs. J. Hart first, Mrs. Biederman second, and Mrs. Berry third.

Sack race for men. Jack Hart first, W. Brown second, and ApRoberts third.

Three legged race, men with women partners. Les Belger and Ann Sloan first, Mr. and Mrs. Stanley Rynkofs second, and Mr. and Mrs. E. R. Holman third.

Three men three legged race. Stanley Rynkofs, Walt Aliphant, and Les Belger first.

Peanut race for women. Ann Sloan first, Mrs. Biederman second, and Mrs. Stanley Rynkofs and Betty Vasquez tied for third.

Mens 200 yard race. Dick Luke first, Les Belger second, Stanley Rynkofs third, and Ray Vasquez Jr., fourth.

The next event was termed the army game, introduced by Ed. Wells, was played as follows: Five men or more on two sides, lined up facing each other about 50 yards apart. Two men holding stakes upright. One man from each side runs out, places both hands on top of the stake, bends and places his forehead on his hands and runs around the stake 10 times then runs back to his side and touches the next man and so on. If you don't think it is fun try it. The winning team for the men, Stanley Rynkofs, ApRoberts, Erwin Frauenhoff, Les Belger, and G. Biederman. Womens team, Betty Vasquez, Mary Rynkofs, Gene Vasquez and Ann Sloan.

Everyone was getting tired by this time so we all sat down and had some more ice cream and did a little more plating, and then home with everyone having had a good time.

C. C. McLAREN, *Secy.*

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Membership Report

MAURICE R. CALDWELL, *Chairman, Membership Committee*

To August 1, 1942

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TRANSFERS

F. Serot from Montreal to San Francisco
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SUSPENSIONS

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REINSTATEMENT

Fred Hurst, Newark Branch

DEATHS

H. Magnus, Chicago Branch
Patrick J. Kelley, Dayton Branch

RESIGNATIONS

W. W. Hall, Associate, Philadelphia Branch

NEWS ITEM

A joint educational session and banquet is to be held by the Buffalo, Rochester and Toronto branches on Saturday, October 24, 1942, 2 p.m. at the General Brock Hotel in Niagara Falls, Ontario.

The speakers will be Mr. William Phillips on "Bright Copper Plating from Acid Solutions", and Mr. A. W. Logozzo on "Hard Chrome Plating." Dinner will be served at 7 p.m. followed by dancing at 10. The ladies will be served tea during an afternoon of bridge in the Rainbow Room.

The price is $2.50 per person, dancing $1 per person. Members of all branches are cordially invited.